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[To be continued.]

II.—On Sphæronites and some other genera from which *Crinoidea* originate. By L. VON BUCH*.

PERHAPS there are few schemes of general structure sketched by Nature within whose circle so many and so variously modified forms have been unfolded as the beautiful Lilies of the Ocean, the *Encrinites* or *Crinoidea*. From their simple origin they diffuse themselves in every direction to the most wonderfully complex and numerous forms, and then suddenly return in the progress of creation to a proportionately small number; so much so, that of the numerous genera and species of the primitive age, only the solitary *Pentacrinus* has come down to our present period. But other forms have unfolded and diffused themselves in all oceans. The corolla of the lily has again closed, and perfectly enveloped *Asteriæ* and *Echini*, capable of greater movement and development, have taken the place of the *Crinoidea*.

No formation can produce a greater number of the most varied forms of these creatures of the primitive age, than the transition formation from the oldest strata to the carbonaceous series. Their chief character in this period is, that the parts which envelope the body have still greatly the superiority over the auxiliary members which are to convey the nutriment, the far-spread many-fingered arms. This body becomes smaller and smaller, and consists of fewer pieces in the Jura formation; the arms and fingers are on the contrary longer, more compound, and in greater number. With *Comatula* or the *Euryalæ*, the body separates entirely

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But before the ocean-lily had opened and expanded its arms, it moved on a short pedicel in the closed state in innumerable quantity, and only by frequent and highly varied attempts did this rupture and expansion succeed. These closed *Crinoidea* are still but little and imperfectly known; they deserve to be known, however, in every respect. For hitherto no *Encrinus* has been found in the lower beds, and from them there is formed an uninterrupted transition to the *Pentacrinus* of the existing ocean. Hitherto these forms have occurred almost exclusively in northern countries; in Sweden, in Norway, and in the hills which bound St. Petersburg on the south; and among them the *Sphæronites* are most frequently met with.

These are large round spheres, like oranges, with two poles at the extremities. Linnæus, in his journey through Oeland, called them crystal-apples. Gyllenhahl, in an able investigation and description (1772), was however the first to recognize their organic nature, and concluded that they might be placed near to *Echinus*, on which account Wahlenberg applied to them the name *Echinosphærites*, which Hisinger has exchanged for the better one of *Sphæronites*. These spheres are formed of numerous polyhedrous plates, generally hexagonal, perhaps of two hundred in one specimen. Above opens a mouth, which is covered by a number of very small moveable shields. Below, a petiole of thin pentagonal articulations fixes the body to the soil. The plates are all perforated. In *Sphæronites Aurantium* these small pores stand in a row from each angle of the polyhedron towards the centre, yet not quite up to the centre itself. Each of these pores is connected by a deep furrow with the adjacent plate, thus giving rise to *rhombs*, which always extend over two plates or *assulæ*; sometimes so prominently, that the rhombs themselves have been taken for *assulæ*, and a species erroneously named *Sphæronites Granatum*, because a similarity was found in these rhombs to the surfaces of a granite crystal. But Gyllenhahl had long before shown that the true polyhedrous *assulæ* bisect the rhombs in the shorter diagonal, and at right angles with their striping. Pander, however, proves what had escaped Gyllenhahl, that these stripes or grooves connect tentacular apertures, as two pores do in the ambulacra of the species of *Cidaris*. And therefore it is very probable that *Ischadites Koenigii* (Murch. Silur. Syst. Pl. 26. fig. 11.) is only *Sphæronites Aurantium*, upon which an outline has been given to the rhombs not belonging to them, and distorting the whole. This discovery of Pander of tentacular passages,

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and consequently of tentacula, is important. They reappear on many *Encrinites*; for instance, on *Actocrinites*, on *Rhodocrinites*, and even on *Marsupites*. (Bronn, Lethæa, Pl. IV.) The rhombs are not evident on the surface of *Sphæronites Pomum*. Each plate bears a number of small systems, separated *inter se*. Two pores are always connected with one another, but these systems are scattered without arrangement over the entire surface. This species has hitherto only been found in Sweden.

In the upper half of the *Sphæronites*, but still a fourth of the sphere distant from the mouth, there is a large pentagonal aperture, which is closed by five triangular valves projecting in a flattened pyramid. Gyllenhahl and his successors call this aperture the mouth. But analogy with the allied forms requires the mouth to be above, and an aperture closing *exteriorly* appears little adapted for a nutriment-receiving mouth. Probably it is an oviduct. Above, quite close to the mouth, and *constantly to the right* of the valvated aperture, there is a third very small opening, penetrating deep into the interior, probably an anus. A similar small anal aperture is likewise evident between three laminæ on *Apiocrinites*, where hitherto it has not been observed, resembling the anus of the living *Comatula*. Gyllenhahl expressly states, "I always found this *Sphæronites Pomum* in Westgothland, at a greater depth than *Sphæronites Aurantium*, and in far greater number." It is therefore surprising that it has not yet been met with in the neighbourhood of St. Petersburg.

Hemicosmites pyriformis.—By means of this beautiful and extremely elegant form, we approach a great step nearer to the true *Crinoidea*. Although still without arms and closed, there are already here but few plates or *assulæ*, in definite number and regularly combined. The *Hemicosmites* is reverse pear-shaped, and consists of three parts, of *pelvis*, *thorax*, and *vertex*. The pelvis on the slender pentagonal petiole is formed of *four pieces*, which are arranged in a hexagon. Two of them are pentagons, the two others lozenges (rhombs). Six *costals* in two different groups form the thorax. Three of these plates are narrower, and above, between those on the left, there is a *pentagonal aperture closed with valves* as in *Sphæronites*. The three other *assulæ* are broader, and the superior apex of the elongated hexagon is somewhat truncated. In accordance with this, the vertical plates arching over the whole also divide into two groups; on the side of the broader *assulæ* there is on each truncation of their apex a longitudinal piece, as it were, inserted, and there are therefore three such pieces; they are wanting on the side of the valvate aperture. The exceedingly small laminæ which cover the mouth on the top

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of the vertex, appear to terminate in three small processes or arms which are pierced, and might perhaps form distinct oval apertures. No anal aperture is evident. The great regularity of this arrangement is still more evident from the great elegance with which prominences are distributed in series over each assula of thorax and vertex. They proceed on the costals from the centre to the *upper* angle of the hexagon, none towards the lower. On the vertical assulæ, on the contrary, these series go towards the *lower* angles, none towards the upper. Only the halves of the surfaces are decorated in this remarkable manner. The vertical and lateral series thus combine to form a highly elegant wreath environing the whole figure. These warts or prominences are pierced in the centre, and appear to be points of adhesion for spines. The central series of each assula is double. On the other parts of the assular surface there are but few similar warts scattered without any order.

Cryptocrinites regularis and *C. Cerasus* (Pander, t. ii. f. 24. n. 26.).

The pelvis is that of a *Platycrinites*, the thorax that of a *Poteriocrinites*; but the vertex is still closed, and without arms. However, five ribs or rings extending from the lower extremity to the vertex are hidden beneath the assulæ, which are thus raised exactly in the form of a roof, just as may be observed in *Actocrinites* before the arms divide. The essential character of the *Crinoidea* exists, therefore, almost entirely in the *Cryptocrinites*, but it is yet hidden in the interior. The pelvis consists of *three plates*, which are united to form a pentagon, an arrangement which again occurs in *Platycrinites*, in *Rhodocrinites*, and in *Actocrinites*, but only in the older ones; in the later Jura *Crinoidea* it is no longer found. The thorax is surrounded by *five costals*, and the vertex likewise by *five plates*, which alternate with the costals. Minute plates surround the mouth, which is for the most part open. Between the vertex and costals there is again a large *aperture covered by five valves*. In *Cryptocrinites Cerasus*, intercostals are, moreover, situated on the original five of the thorax, thus somewhat disturbing the regularity of the upper half; and there are also probably more than five assulæ or plates on the vertex. The side on which the valvate aperture is situated is bulged out at all points; the effort of the hidden arms to break through the sides is here evident. The size of these animals seldom exceeds that of a pea; the petiole which bears it has the thickness of a pin. Hitherto they have occurred solely in the hills near St. Petersburg.

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